Claims

[c1] 1.A system for measuring a condition of a turbine engine component, said condition being selected from the group consisting of temperature, strain, and combination thereof, said system comprising:
a first electrically non-conducting film comprising a material selected from the group consisting of dielectric materials and electrically insulating materials, said first film being disposed on a substrate of said turbine engine component without a removal of a substrate material to compensate for a thickness of said first electrically non-conducting film;
at least a film of an electrically conducting material disposed on said first electrically non-conducting film; and
means for measuring a change in a property of said at least a film of said electrically conducting material, said change in said property relating to said condition of said turbine engine component;
wherein said first electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said electrically non-conducting film and said at least a film of said electrically conducting material remain adhered to films and substrates adjacent thereto through at least a cycle of extreme operating temperature.

[c2] 2.The system according to claim 1, wherein a thermal strain between two adjacent films is maintained at less than about 0.006.

[c3] 3. The system according to claim 1 further comprising a second electrically non-conducting film disposed on said first electrically non-conducting film and said at least a film of an electrically conducting material, wherein said second electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said electrically non-conducting films and said at least a film of said electrically conducting material remain adhered to films adjacent thereto through at least a cycle of extreme operating temperature.

[c4] 4.The system of claim 1, wherein said condition is a temperature, and said at least a film of an electrically conducting material extends beyond an edge of

said first electrically non-conducting film to form a thermocouple junction with said substrate.

[c5] 5.A system for measuring a temperature of a turbine engine component, said system comprising:
a first electrically non-conducting film comprising a material selected from the group consisting of dielectric materials and electrically insulating materials, said first electrically non-conducting film being disposed on a substrate of said turbine engine component without a removal of a substrate material to compensate for a thickness of said first electrically non-conducting film;
two spaced-apart films of different electrically conducting materials disposed on said first electrically non-conducting film, said two spaced-apart films joining at one end to form a thermocouple junction; and
means for measuring a change in a property of said at least a film of said electrically conducting material, said change in said property relating to said condition of said turbine engine component;
wherein said first electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said electrically non-conducting film and said two spaced-apart film of said electrically conducting material remain adhered to films and substrates adjacent thereto through at least a cycle of extreme operating temperature.

[c6] 6.The system of claim 5 further comprising a second electrically non-conducting film disposed on said first electrically non-conducting film and said two spaced-apart films of electrically conducting materials to sandwich said electrically conducting materials between said first and second electrically non-conducting films, wherein said second electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said first and second electrically non-conducting films and said two spaced-apart films of said electrically conducting materials remain adhered to films adjacent thereto through at least a cycle of extreme operating temperature.

[c7] 7.The system of claim 5 for measuring a temperature of a turbine engine component, further comprising a third electrically non-conducting film

disposed between said two spaced-apart films of electrically conducting materials.

[c8] 8.The system of claim 5 for measuring a temperature of a turbine engine component, wherein said first and second electrically non-conducting films comprise materials independently selected from the group consisting of AlN, BN, MgO, TiO_2, ZrO_2, La_2O_3, Cr_2O_3, ThO_2, BeO, a mixture of NiO and Al_2O_3, and mixtures thereof.

[c9] 9.The system of claim 5 for measuring a temperature of a turbine engine component, wherein at least one of said electrically conducting materials is selected from the group consisting of alloys of Pt-Rh, Pt-Pd, Rh-Pd, Zr-Pt-Rh, Au-Pt-Rh, Ag-Pt-Rh, Zr-Pt-Pd, Au-Pt-Pd, Au-Cr-Ru-Ni, Au-Pt, Au-Pd, W-Re, Ni-Cr, Ni-Mn-Al, Mn-Ni, Ni-Cr-Si-Mg, Ni-Si-Mg, Ni-Co, and Ni-Mo.

[c10] 10.A turbine engine component comprising:
a substrate;
a first electrically non-conducting film comprising a material selected from the group consisting of dielectric materials and electrically insulating materials, said first electrically non-conducting film being disposed on a substrate of said turbine engine component without a removal of a substrate material to compensate for a thickness of said first electrically non-conducting film; and
at least a film of an electrically conducting material disposed on said first electrically non-conducting film;
wherein said first electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said electrically non-conducting film and said at least a film of said electrically conducting material remain adhered to films and substrates adjacent thereto through at least a cycle of extreme operating temperature.

[c11] 11.The turbine engine component of claim 10 further comprising a second electrically non-conducting film disposed on said first electrically non-conducting material and said at least a film of an electrically conducting material, wherein said second electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said first

and second electrically non-conducting films and said at least a film of said electrically conducting material remain adhered to films adjacent thereto through at least a cycle of extreme operating temperature.

[c12] 12.The turbine engine component of claim 10, wherein said at least a film of an electrically conducting material extends beyond an edge of said first electrically non-conducting film to form a thermocouple junction with said substrate.

[c13] 13. The turbine engine component of claim 11, wherein said at least a film of an electrically conducting material comprises two spaced-apart films of different electrically conducting materials joining together at one end to form a thermocouple junction.

[c14] 14.The turbine engine component of claim 13, further comprising a third electrically non-conducting film disposed between said two spaced-apart films of electrically conducting materials.

[c15] 15.The turbine engine component of claim 11, wherein said first and second dielectric films comprise materials independently selected from the group consisting of AlN, BN, MgO, TiO_2, ZrO_2, La_2O_3, Cr_2O_3, ThO_2, BeO, a mixture of NiO and Al_2O_3, and mixtures thereof.

[c16] 16.The turbine engine component of claim 10, wherein said electrically conducting material is selected from the group consisting of alloys of Pt-Rh, Pt-Pd, Rh-Pd, Zr-Pt-Rh, Au-Pt-Rh, Ag-Pt-Rh, Au-Cr-Ru-Ni, Zr-Pt-Pd, Au-Pt-Pd, Au-Pt, Au-Pd, W-Re, Ni-Cr, Ni-Mn-Al, Mn, Ni, Ni-Cr-Si-Mg, Ni-Si-Mg, Ni-Co, and Ni-Mo.

[c17] 17.A method for making a system for measuring a condition of a turbine engine component, said condition being selected from the group consisting of temperature, strain, and combination thereof, said method comprising: depositing a first electrically non-conducting film on a substrate of said turbine engine component without removing a substrate material to compensate for a thickness of said first electrically non-conducting film, said first electrically non-conducting film comprising a material selected from the group consisting of dielectric materials and electrically insulating materials;

depositing at least a film of an electrically conducting material on said first electrically non-conducting film; and

providing a means for measuring a change in a property of said at least a film of said electrically conducting material, said change in said property relating to said condition of said turbine engine component;

wherein said first electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said first electrically non-conducting film and said at least a film of said electrically conducting material remain adhered to films and substrates adjacent thereto through at least a cycle of extreme operating temperature.

[c18] 18. The method of claim 17 further comprising depositing a second electrically non-conducting film on said first dielectric material and said at least a film of an electrically conducting material to sandwich said electrically conducting material between said first and second electrically non-conducting films, wherein said second electrically non-conducting film comprises a material that has a thermal expansion coefficient selected such that said first and second electrically non-conducting films and said at least a film of said electrically conducting material remain adhered to films adjacent thereto through at least a cycle of extreme operating temperature.

[c19] 19.The method according to claim 17 for making a system for determining a condition of a turbine engine component; wherein each of said steps of depositing comprises delivering a mixture, which comprises a powder dispersed in a liquid medium, at a substantially constant rate through a nozzle onto a surface, said nozzle has an orifice from about 10 nm to about 250 micrometers, and said nozzle is spaced apart from said surface at a substantially constant distance.

[c20] 20. The method according to claim 19, further comprising heat treating a film after depositing said film and before depositing an adjacent film.

[c21] 21.The method according to claim 20, wherein said heat treating comprises locally heating with a beam of energy selected from laser and electron heating.

[c22] 22.The method according to claim 20, wherein said heat treating comprises annealing in a furnace.

[c23] 23.The method according to claim 17, wherein said depositing at least a film of an electrically conducting material on said first electrically non-conducting film comprises depositing two spaced-apart films of different electrically conducting materials such that said space-apart films join at one end to form a thermocouple junction.

[c24] 24.The method according to claim 17, further comprising depositing a third electrically non-conducting material between said two spaced-apart films of electrically conducting materials.

[c25] 25.A method for determining a condition of a turbine engine component, said condition being selected from the group consisting of temperature, strain, and combination thereof, said method comprising:
providing a system on a surface of said turbine engine component for measuring said condition, said system comprising at least a film of an electrically conducting material disposed on an electrically non-conducting film;
measuring a change in a property of said at least a film of said electrically conducting material; and
relating said change in said property to said condition of said turbine engine component.

[c26] 26.A method for measuring a condition of a turbine engine component, said condition being selected from the group consisting of temperature, strain, and combination thereof, said method comprising:
providing a system on a surface of said turbine engine component for measuring said condition, said system comprising at least a film of an electrically conducting material disposed on an electrically non-conducting film;
measuring a change in a property of said at least a film of said electrically conducting material;
relating said measurements on said change in said property to said condition of said turbine engine component; and
transmitting said condition to a remote data collection station through a

communication link.

[c27] 27. The method according to claim 26, wherein said property of said film is selected from the group consisting of electrical potential generated in said film and electrical resistance.

[c28] 28.The method according to claim 26, wherein said communication link is selected from the group consisting of telephone lines with associated modems, radio frequency transmission, microwave transmission, satellite transmission, and combinations thereof.

[c29] 29.The method according to claim 28, further comprising:
monitoring said condition;
detecting a condition that is outside a predetermined limit; and
performing maintenance on said turbine engine component.